

Interactive comment on “Global and regional performances of SPI candidate distribution functions in observations and simulations” by Patrick Pieper et al.

Anonymous Referee #1

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General comments

The SPI (Standardized Precipitation Index) is a commonly and widely used index to detect droughts based on precipitation data. It can be applied to several aggregation periods of precipitation, e.g. 1 month, 3 months, 6 months etc., tailored to the different drought impacts (meteorological drought, agricultural drought, hydrological drought, ...). In doing so, a distribution function is fitted on the precipitation data and transformed to a standard distribution. This gives the possibility to detect and compare droughts over time and space. The curtail point is the reproduction of the standard distribution by the transformed original distribution. Here, the paper investigate the

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suitability of four distribution functions with observed and forecasted precipitation data for the SPI. The goal of this paper is to propose one distribution function applicable to observed and forecasted precipitation totals globally for all useful aggregation periods. The paper is well and clear written and addresses the scientific question well.

Specific comments

- You wrote in lines 164 to 167 that you use three different procedures to estimate the parameters of the distribution function. Therefore I expect to get analyses of three procedures times four distributions equals to twelve analyses per observations and simulations. You showed only one per distribution. Which of the procedures did you use finally to fit the parameters of the distribution functions? This is also relevant as you wrote in section 3.1.3 that the procedure of estimation the distribution function parameters could have an impact on the usability of the derived parameters. - Do you exclude grids without converging parameter fits from the further analysis or do you use another procedure to estimate the parameters? Line 167/168 - Your sample sizes differ by a factor of ten between observations and forecasts (e.g. lines 198 or 277). In line 277, you wrote that the reliability of the parameters depends on the sample size and is therefore better for the modelled than for the observed data. Nevertheless, if you analyse the usability of distribution functions for the SPI, you should have parameter estimations with the same reliability. I propose to repeat the analysis with only one ensemble member and add that to the paper and add a short analysis on the impact of the available amount of data to the reliability of the SPI. - Lines 282 to 285: In this paragraph is no transition from absolute to relative AIC, which need to be improved. In addition, the index i is not well described. - Lines 224 to 226: Do you avoid parameters in the GGD3 to become GD2 or WB2? - Section 2.7: Your region are large enough to cover several precipitation regimes in one region. I propose to reduce the size of the regions and select regions with known good/bad model performance and different precipitation regimes. - Line 355: How do you calculate the “weighted sum”? Please add a description. - Line 574: You stated a phase transition of the SPI at 3 months

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precipitation accumulation. However, I cannot see it in Figure 4. What do you mean with phase transition? - Section 4: Do you compare the same number of grid cells for observations and forecasts? In addition, do you compare the same grid cells? I assume different sets of selected grid cells for your analyses can have an impact on the results. - Lines 604/605: I think the investigations to the empirical cumulative distribution functions are very relevant for this topic and should be added to the paper or, at least, add a reference to the paper where you want to describe it. - Section 5: The base problem, from my point of view is, that the models are not able to reproduce the observed precipitation distribution function and procedures developed on observed data need to be adapted to be applied to model data (the GD2 performs well on the observed data). That is the base of your research and you should comment on this here or in the introduction. - Figure 6: Can you add the global average, as for Figure 4, as an additional domain to this figure?

Technical corrections

- Lines 379/380: It was not clear what was set in relation to what. Please reword this part. - Line 527: I think you to refer to Figure 8 and not to Figure 7. - Line 583: I think you want to refer to “GD2” instead of “GGD2” (typo). - Figure 4: Add to the caption that it is for global average.

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